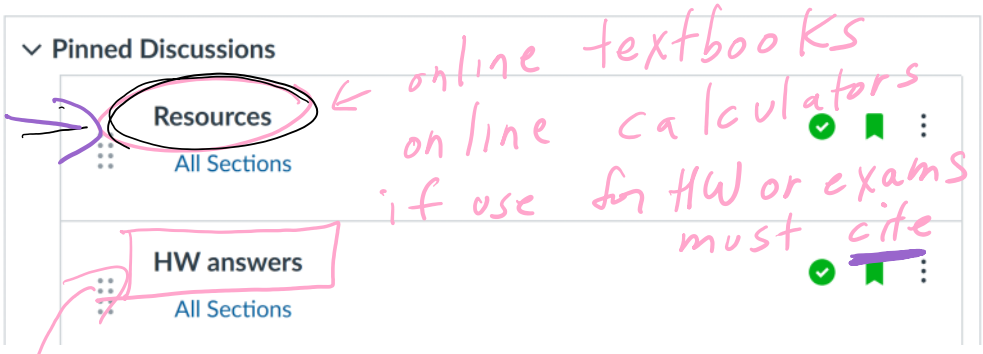


online textbooks
online calculators
if use for HW or exams must cite

Homework will normally be due on Wednesdays. Each problem will be worth 5 points. Some HW problems will be graded, while others will only be checked for completion. **THUS YOU SHOULD CHECK YOUR ANSWERS.** Answers to almost all problems (both even and odd) are available in the back of your textbook. **After your HW has been turned in, if you would like feedback or a more complete answer for a particular problem, please respond to this post.** If you have questions before HW is due, please e-mail me (include 2560 in subject line) or come to office hours.

For the next 3 Mondays, we will try out asynchronous lectures. Thus we will not have a regular lecture for the next 3 Mondays (see video webpage for videos that you should watch instead). However,

- you should come to class to work on HW on these Mondays.
- While this is not required, I will be available to answer any questions.
- We can also have breakout rooms where students work together on a particular problem (you can invite me to the breakout room if you have questions).
- People learn more and retain more knowledge by actively working with others.
- This would be good practice for the real world, where many jobs have an online collaborative component.

Please watch the week 1 videos this week. I will talk more about videos and quizzes this Friday.

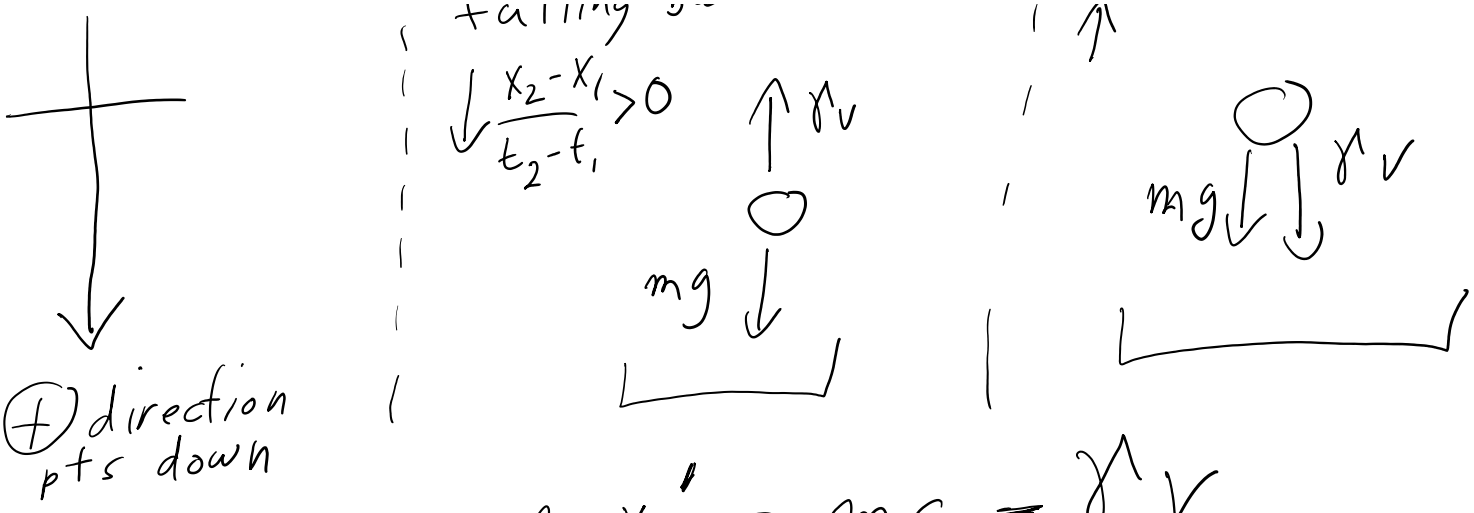
go to syllabus, click on videos

top of page

1.1 Ball example,

falling ball $v > 0$, moving up $v < 0$ ↑

$x_2 - x_1 < 0$



$$m v' = mg - \gamma v$$

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ex $m = 10, \gamma = 2 \Rightarrow v' = 9.8 - \frac{v(t)}{5}$

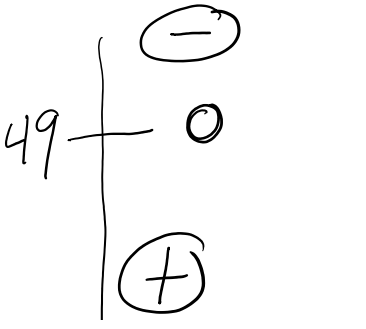
Are there any equilibrium solns?

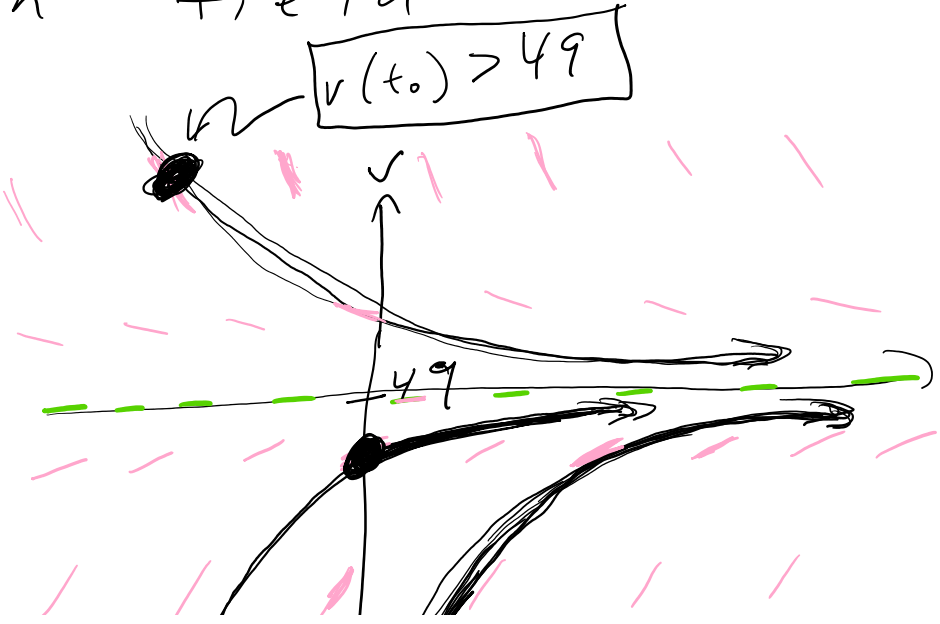
ie a constant soln $v = k \iff v' = 0$ for all t

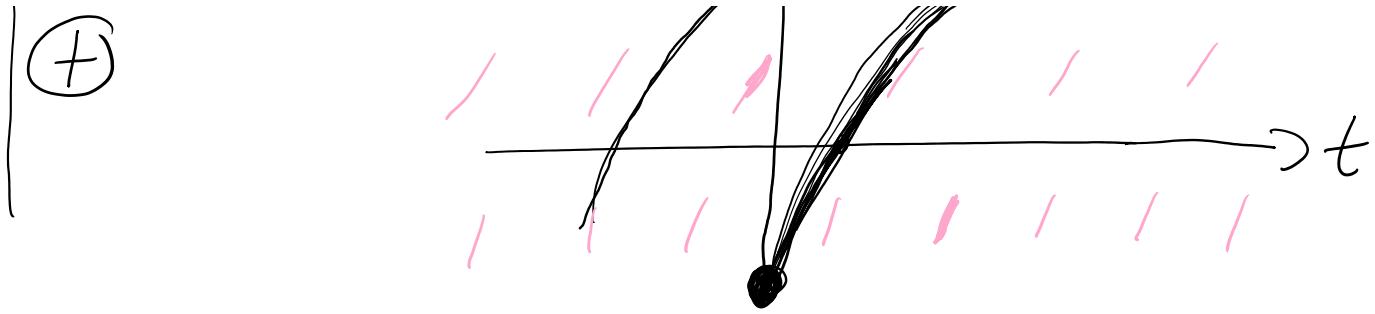
$$0 = 9.8 - \frac{v}{5} \Rightarrow v = 49$$

Direction field = draw small portions of tangent lines

$v' = 9.8 - \frac{v}{5}$







$v(t_0) > 49$ for some $t_0 \Rightarrow$

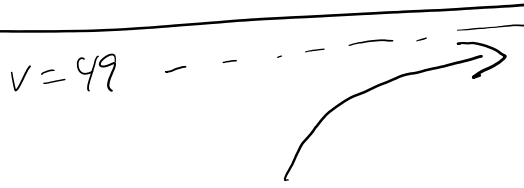
so velocity of ball slows, approaching 49 m/sec as $t \to \infty$

$\boxed{v' = mg - \gamma v}$ (γ large $\Rightarrow$ air resistance dominate so ball slows down

---

$v(t_0) = 49 \Rightarrow v(t) = 49$ for all t

equilibrium soln



$v(t_0) < 49$

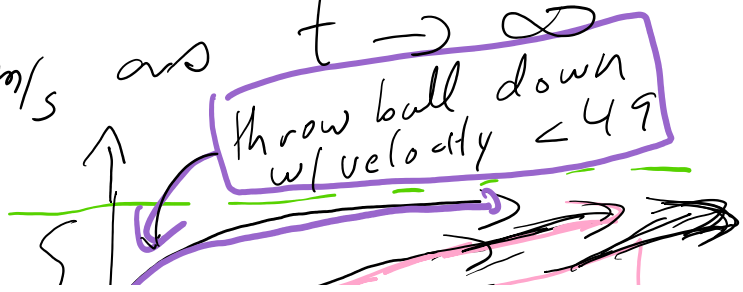
$\boxed{v' = mg - \gamma v}$ ← gravitional force dominate

smaller or negative

velocity increases

from direction field

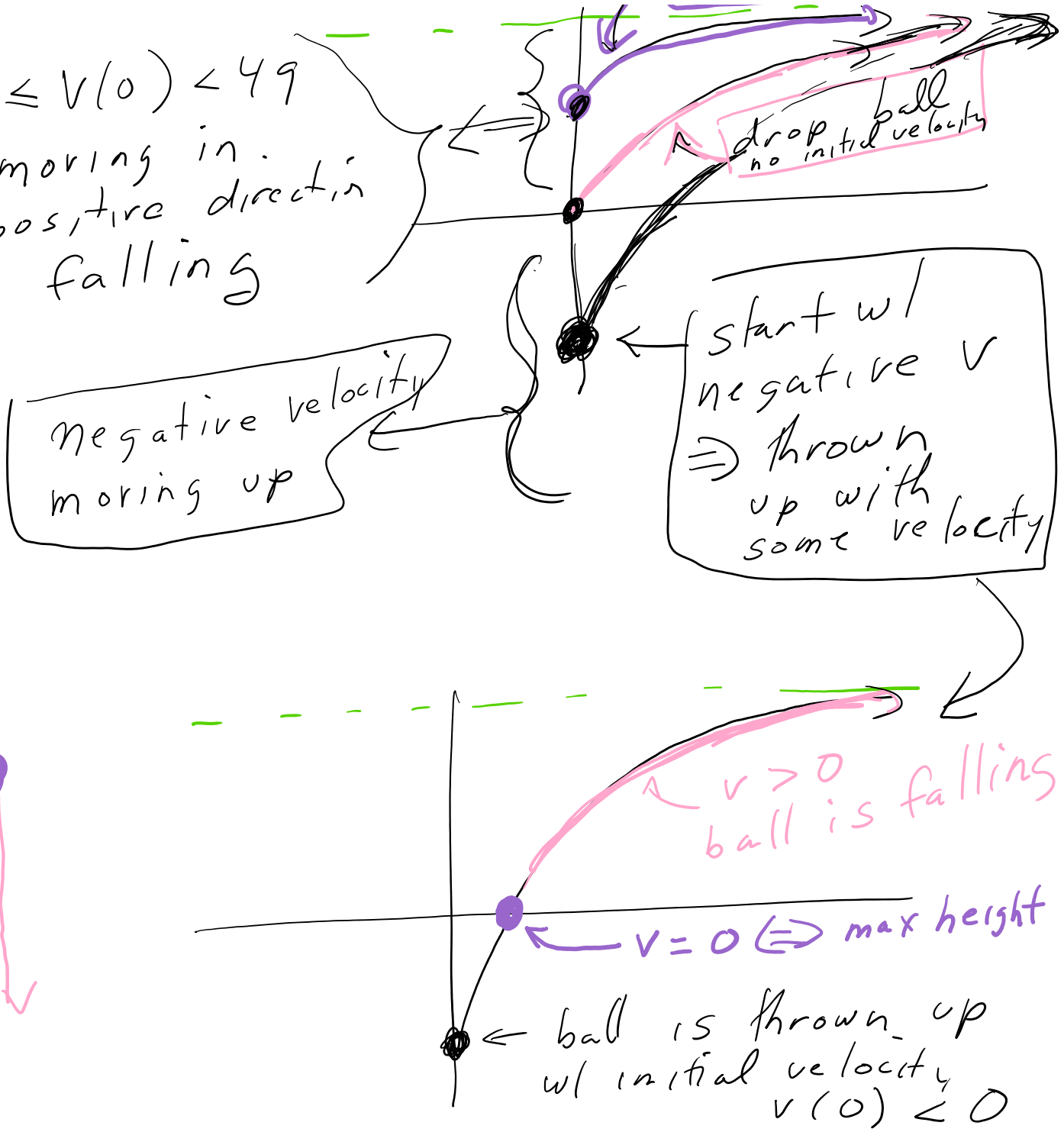
$v \to 49$ m/s as $t \to \infty$



$0 \le v(0) < 49$

$\Rightarrow$ moving in positive direction

$\Rightarrow$ falling



Solve $\dfrac{dv}{dt} = 9.8 - \dfrac{v}{5}$

2.2 = 1.2 : Separate variables to turn DE into a calculus 1 problem

get rid of fraction if you like

$$5\,dt\left(\frac{dv}{dt}\right) = \left(9.8 - \frac{v}{5}\right)5\,dt$$

$$\frac{5\,dv}{49-v} = \frac{(49-v)\,dt}{49-v}$$

did not distribute dt since goal is to separate variables

Calc 1 problem

$$\int \left(\frac{5}{49-v}\right) dv = \int dt$$

$$-5\ln|49-v| = t + C$$

check integration by taking derivative.

You can also use ... let $u = 49-v$

$\int f(v)\,dv$ (height)(width)

dv & dt should never be in denominator

(height) · width

dv or dt

You can also use
u-substitution: let $u = 49 - v$
$du = -dv$

$\frac{dv}{dt}$

$$\frac{-5 \ln|49 - v|}{-5} = \frac{t}{-5} + \frac{C}{-5}$$

Solve for v

$$\ln|49 - v| = -\frac{t}{5} + C$$

these C's have different meaning

e e

$$|49 - v| = e^{-\frac{t}{5} + C}$$

$$= \left(e^{-\frac{t}{5}}\right)\left(e^{C}\right)$$

$$|49 - v| = Ce^{-t/5}$$

↑ since e^C is a constant

$\frac{C}{-5}$ is a constant

$C \neq \frac{C}{-5}$

but we will be sloppy and allow constants to swallow other constants

$$49 - v = \pm Ce^{-t/5}$$

↑ $\pm C$ is a constant

$$-(49 - v) = -Ce^{-t/5}$$

C swallowed sign

$$-49 + v = Ce^{-t/5}$$

$$v = Ce^{-t/5} + 49$$

soln to $v' = 9.8 - \frac{v}{5}$

solve for v